REMARKS

Applicants appreciate the thoroughness with which the Examiner has examined the above-identified application. Reconsideration is requested in view of the amendments above and the remarks below.

For purposes of appeal, claims 1 and 12 have been amended for clarification purposes only. It is submitted that these amendments would not require a further search of the art since the pending limitations have already been searched.

No new matter has been added.

Rejection under 35 USC § 112, first paragraph

The Examiner has rejected amended claim 13 under 35 U.S.C. 112, first paragraph, stating that the specification does not reasonably provide enablement for the solvent being "aliphatic hydrocarbons, aromatic hydrocarbons, naphthenic hydrocarbons and combinations thereof" to dissolve the claimed salts. The Examiner takes the position that the solvents recited in claim 13 are NOT polar solvents, and as such, cannot dissolve salts, which are ionic (polar) compounds.

Applicants disagree and submit a partial printout of the URL "umanitoba.ca/chemistry/courses/chem222/.../solvents_and_reagents.pdf," which is a chemistry guide for students, attached hereto as Appendix D. As is described in this chemistry guide, hydrocarbon solvents will dissolve low polarity organics. Salts, including at least some of those listed in claim 12, are known to be low polarity organics.

<u>**Specification and Claim Objections**</u>

The Examiner continues to object to the specification and claim 12 stating that the recitation of a 'soluble salt, such as KOH' is "not a proper term for KOH, since by definition the salt is "a compound, that results from replacement of the acid hydrogen of an acid by a metal or a group acting like a metal" citing (Merriam-Webster's Collegiate Dictionary, tenth edition, page 1032).

Applicants continue to disagree with the Examiner, and once again, submit that it is common knowledge that alkalis are basic ionic salts of an alkali metal (PH value of greater than 7) of which a common example is potassium hydroxide (i.e., KOH which is often called "potash"). To support applicants' position, attached hereto are copied pages from the *CRC Handbook of Chemistry and Physics,* 66th Ed., CRC Press, Inc. 1985, pgs. D-1— and D-107 (Appendix A) and a general chemistry book entitled *Chemistry*, James P. Birk, Houghton Mifflin Company, 1994, pg. 103 (Appendix B), both which establish that that KOH is in fact a salt. It is submitted that TEAH, TBAH and TMAH are also salts, in particular, quaternary ammonium salts, as is supported by the Internet printouts attached hereto as Appendix C, as well as is supported by the Examiner's 103 rejection with respect to Sachdev (U.S. Publication No. 2002/0000239).

With respect to the terms "1,4-dioxane" and "organic surfactant" in claim 12, applicants have canceled such limitations for purposes of expediting allowance of the present application.

It is for these reasons that applicants submit that both the specification and the claims are in a condition for allowance.

Claim Rejections under 35 USC § 103

Stephanie et al (U.S. Patent No. 5,891,257.

The Examiner has rejected claims 1-4, 6, 7, and 9 under 35 U.S.C. 103 (a) as being obvious over Stephanie et al (U.S. Patent No. 5,891,257).

Independent claim 1, from which claims 2-4, 6, 7 and 9 depend, is directed to locally removing polymer sealant from a semiconductor device by providing a component having a thermoset polymer sealant on a surface thereof and detecting the thermoset polymer sealant on a portion of such surface. Bulk thermoset polymer sealant is removed, and residual thermoset polymer sealant remaining on such portion of the surface is detected after the bulk thermoset polymer sealant has been removed. The substrate is heated to a temperature under the boiling point of the solvent of the solution, and a depolymerization cleaning solution is locally applied substantially only to the residual thermoset polymer sealant in an amount sufficient to at least cover the residual thermoset polymer sealant. An essential feature of the invention is that this depolymerization cleaning solution is a salt saturated solution having surfactant. The residual thermoset polymer sealant is contacted with the present depolymerization cleaning solution to chemically degrade such residual thermoset polymer sealant for the removal thereof. The degraded residual thermoset polymer sealant is then removed from the surface of the component.

Applicants continue to submit that Stephanie et al. discloses a tool 12 with a flow head 14 having a support 22 with an opening 22′ adapted to contact a circuit board and

flow solvent to the surface of the board. (Col. 3, ll. 33-46 and FIG. 3.) An opening 24′ of a solvent nozzle 24 is used to apply solvent to the circuit board using scrubbing action during application of the solvent. (Col. 3, ll. 50-57.)) In Stephanie et al., the solvent is heated, the support 22 contacts the substrate assembly, the solvent flows over the encapsulated chip 30' and the flow head 14 is lowered to remove encapsulation. (Col. 7., l. 62 to col. 8, l. 13-25.) In accordance with Stephanie et al., the scrubbing action is effective in removing the resin from the particular intended device. (Col. 5, ll. 2-4.)

Applicants continue to submit that Stephanie et al. does not disclose, contemplate or suggest that its *cleaning solution* is a salt saturated solution having surfactant, as is claimed. Rather, Stephanie et al. is limited to unsaturated solutions of an alcohol, an acid, and an organic solvent. (Col. 8, ll. 43-55.) The solvent comprises 10-100 parts of a primary alcohol and 0-90 parts of a less polar organic solvent as exemplified by benzyl alcohol, xylene, toluene; and one to ten parts of an organic acid as exemplified by methanesulfonic acid, p-toluenesulfonic acid and trifluoromethanesulfonic acid. Additionally, about 30 parts of ethylene glycol is used in the solvent, and optionally a surfactant and/or or a corrosion inhibitor. (Col. 9, ll. 18-28.)

It is the Examiner's position that the cleaning solution of the present invention becomes unsaturated as soon as it is heated, and as such, applicants' cleaning solution is no different than that disclosed in Stephanie et al. Applicants disagree.

An essential feature of the invention is that the present cleaning solution is saturated with salt. That is, applicants' cleaning solution has a high concentration of salt (solute) –to the point that the solution can hold no more salt (i.e., it is saturated). Once the

temperature of the cleaning solution is increased, even though the solubility of the solution may vary, the initial increased concentration or amount of salt in solution remains the same. Stephanie et al. does not disclose, contemplate or suggest that its initial cleaning solution (i.e., before heating) is a saturated solution, and as such, does not have as high a concentration of solute in solvent as does the cleaning solution of the present invention, which again, is a saturated solution. The saturated cleaning solution of the invention is different than the unsaturated cleaning solution of Stephanie et al. To support this position, applicants point out that Stephanie et al. discloses that a scrubbing action via nozzle 24′ is used in combination with its solvent for the effective removal of the resin. (Col. 5, ll. 2-4, and col. 5, l. 65 to col. 6, l. 2.) In accordance with the present invention, all that is needed for the effective removal of the residual polymer is applicants' saturated cleaning solution.

Applicants also continue to submit that Stephanie et al. does not disclose, contemplate or suggest the steps of first removing bulk thermoset polymer sealant and then detecting any residual thermoset polymer sealant for the removal thereof, as is currently claimed. The Examiner states that these steps would be within the skill of the art at the time of the invention, however, it is submitted that hindsight and the level of ordinary skill in the art may not be used to supply a component missing from the prior art references. *Al-Site Corp. v. VSI International, Inc.*, 174 F.3d 1308, 1324, 50 USPQ2d 1161, 1171 (Fed. Cir. 1999).

It is respectfully submit that the claims of the instant invention include limitations not disclosed nor contemplated by Stephanie et al. such that Stephanie et al. does not render obvious the instant invention.

Sachdev (U.S. Publication No. 2002/0000239)

The Examiner has also rejected claims 1, 7, 9, 10, 11, and 14 under 35 U.S.C. 103 (a) as being obvious over Sachdev (U.S. Publication No. 2002/0000239).

The Examiner states that Sachdev discloses a stripping solution comprising 0.05-0.5% of a non-ionic surfactant, 0.5-5% of tetralkylammonium hydroxide (the Examiner states that this reads on TEAH, and as such, conflicts with the Examiner's claim and specification objections in the above office action) and a solvent, wherein the solution causes the disintegration of a polymer [0053]. Like that of Stephanie et al., applicants continue to submit that Sachdev does not disclose, contemplate or suggest that its stripping *solution* is a salt saturated solution having surfactant, as is claimed. On the contrary, the tetraalkyl ammonium hydroxide does not saturate the solution. It is only present in an effective amount of about 0.5-5% by weight based on anhydrous material. (Sachdev, Paragraph [0053].) The stripping solution of Sachdev is an unsaturated solution, having a lower concentration of salt as compared to the saturated solution of the invention. As such, the depolymerization cleaning solution of the invention is technically different and distinct from the stripping composition of Sachdev.

With respect to claim 7, the Examiner states that "about 25 minutes," as claimed, permits some tolerance, and therefore, the time disclosed by Sachdev for the cleaning "about 30 minutes" is close and is therefore obvious. To support the Examiner position,

the Examiner cites *Titanium Metals Corp. v. Banner,* 778 F.2d 775,783,227 USPO 773,779 (Fed. Cir. 1985) for the proposition that a prima facie case of obviousness exists when the claimed range and the prior art are close enough such that one skilled in the art would have expected them to have the same properties. However, applicants point out that in *Titanium Metals*, the claimed composition consists of 0.3% Mo and 0.8% Ni while the prior art included 0.25% Mo - 0.75% Ni and 0.31% Mo - 0.94% Ni. The Court in *Titanium Metals* found that these "proportions are so close that prima facie one skilled in the art would have expected them to have the same properties. *Id.* The case at hand is much different than that of *Titanium Metals.* The "proportions" or time range of the present invention ranging from about 5 minutes to about 25 minutes (claim 7) is much different than the time range of Sachdev from 30 minutes to 8 hours (for 30 minutes up to about 2 hours to 8 hours, or more typically for about 60 to 90 minutes, Sachdev, Paragraphs [0026] and [0062].) This is a difference in kind and not a difference in degree. *Becket v. Coe 38 USPQ 26 (CADC 1938); In re Becket et al. 33 USPQ 33 (CCPA 1937), In re Russell 169 USPQ 426 (CCPA 1971).* The prior art time range is not close enough to that of the present invention. *Titanium Metals Corp.,* 778 F.2d at 783, 227 USPO at 779

Applicants also submit that Sachdev does not disclose, contemplate or suggest the steps of first removing bulk thermoset polymer sealant and then detecting any residual thermoset polymer sealant for the removal thereof, as is currently claimed. Applicants again submit that hindsight and the level of ordinary skill in the art may not be used to supply a component missing from the prior art references. *Al-Site Corp,* 174 F.3d at1324, 50 USPQ2d at1171 (Fed. Cir. 1999).

It is respectfully submit that the claims of the instant invention include limitations not disclosed nor contemplated by Sachdev such that Sachdev does not render obvious the instant invention.

Stephanie in combination with Sachdev

The Examiner has also rejected claim 12 under 35 U.S.C. 103(a) as being unpatentable over Stephanie in combination with Sachdev. Applicants disagree

Claim 12, which is ultimately dependent upon claim 1, is directed to components of the instant depolymerization cleaning solution of a salt saturated solution having surfactant. The Examiner recognizes that the solvents recited in claim 12 are not specifically recited in Sachdev. To overcome this deficiency the Examiner states that Stephanie utilizes glycols along with t-butyl alcohol, thus providing the motivation to use one in lieu of the other, and the use of t-butyl alcohol is obvious over the use of n-butyl alcohol, as being structural isomer, and therefore having similar functional characteristics, as per *In re Wilder*, 563 F.2d 457, 460,195 USPQ 426, 429 (CCPA 1977).

However, applicants again submit that neither Stephanie et al. nor Sachdev, alone or in combination, disclose, contemplate or suggest a depolymerization cleaning solution of a salt saturated solution having surfactant, as is currently claimed. Rather, the cleaning solutions of both Stephanie et al. and Sachdev are limited to unsaturated solutions, and as such, have less solute in the solution as compared to the solution of the present invention, which is saturated.

In view of the foregoing, applicants submit that neither Stephanie et al. nor Sachdev, alone or in combination, disclose or suggest doing what applicants have done, such that applicants' invention is unobvious and would only be found based on applicants' own disclosure, which, of course, is improper as a hindsight reconstruction of applicants' invention. *W.L. Gore & Assoc. v. Garlock*, 721 F.2d 1540, 1553 [220 USPQ 303, 312-13] (Fed. Cir. 1983). Any contrary conclusion would be based on hindsight. *Al-Site Corp*, 174 F.3d at 1324, 50 USPQ2d at 1171.

In view of the above remarks, applicants submit that the present invention would not have been obvious to one of ordinary skill in the art at the time of the invention under section 103.

It is respectfully submitted that the application has now been brought into a condition where allowance of the entire case is proper. Reconsideration and issuance of a notice of allowance are respectfully solicited. Should the Examiner not find the claims to be allowable, Applicants' attorney respectfully requests that the Examiner call the undersigned to clarify any issue and/or to place the case in condition for allowance.

Respectfully submitted,

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Appendix A

CRC Handbook of Chemistry and Physics

A Ready-Reference Book of Chemical and Physical Data

HANDBOOK OF CHEMISTRY AND PHYSICS

1985—1986

66th

EDITION

CRC PRESS, INC.

Editor-in-Chief

Robert C. Weast, Ph.D.

Associate Editors

Melvin J. Astle, Ph.D.
William H. Beyer, Ph.D.

In collaboration with a large number of professional chemists and physicists whose assistance is acknowledged in the list of general collaborators and in connection with the particular tables or sections involved.

CRC Press, Inc.
Boca Raton, Florida

Library of Congress Card No. 13-11056
PRINTED IN U.S.A.
ISBN-0-8493-0466-0

CODATA RECOMMENDED KEY VALUES FOR THERMODYNAMICS, 1977
(To convert joules to calories multiply by 0.239006) (continued)

Substance	State	$\Delta_f H^\circ$ (298.15 K) $kJ \cdot mol^{-1}$	S° (298.15 K) $J \cdot K^{-1} \cdot mol^{-1}$	H° (298.15 K) − H° (0) $kJ \cdot mol^{-1}$
Ca	cr	0	41.6 ± 0.4	5.73 ± 0.04
Ca	g	177.8 ± 0.8	154.775 ± 0.020	6.197 ± 0.002
Ca^{+2}	aq	−543.10 ± 0.80	−56.4 ± 0.4	—
CaO	cr	−635.09 ± 0.90	38.1 ± 0.4	6.75 ± 0.06
Li	cr	0	29.12 ± 0.20	4.632 ± 0.040
Li^+	aq	−278.455 ± 0.090	11.30 ± 0.35	—
Na	cr	0	51.30 ± 0.20	6.460 ± 0.020
Na^+	aq	−240.300 ± 0.065	58.41 ± 0.20	—
K	cr	0	64.68 ± 0.20	7.088 ± 0.020
K^+	aq	−252.17 ± 0.10	101.04 ± 0.25	—
Rb	cr	0	76.78 ± 0.30	7.489 ± 0.020
Rb^+	aq	−251.12 ± 0.13	120.46 ± 0.40	—
Cs	cr	0	85.23 ± 0.40	7.711 ± 0.020
Cs^+	aq	−258.04 ± 0.13	132.84 ± 0.40	—

LATTICE ENERGIES

H. D. B. Jenkins

Table 1 contains calculated values of lattice energies, U_{Pot}, of crystalline salts M_aX_b. U_{Pot} is expressed in the units of kilojoules per mole, KJmol^{-1}. M and X can be complex or simple ions. Also cited is the lattice energy obtained from the Born-Fajans-Haber Cycle, $U^{BFHC}{}_{Pot}$ using thermochemical data published in U.S. Government publications plus certain other data which are located at the end of this table. The values quoted are of variable reliability and a full discussion of the values is to appear in a review by Jenkins and Waddington currently (1978) nearing completion.

$$\begin{tikzcd}
M_aX_{b(c)} \arrow[rr, "\Delta H_L"] & & aM^{b+}{}_{(g)} + bX^{a-}{}_{(g)} \\
& aM_{(ss)} + bX_{(ss)} \arrow[ul, "\Delta H_f^\theta(M_aX_g)_{(c)}"] \arrow[ur, "a\Delta H_f^\theta (M^{b+})_{(g)} + b\Delta H_f^\theta (X^{a-})_{(g)}"'] &
\end{tikzcd}$$

where, (ss) is the standard state of the ion or element

$$\Delta H_L = U_{Pot}\,(M_aX_b) + \left[a\left(\frac{n_{M^{b+}}}{2} - 2\right) + b\left(\frac{n_{X^{a-}}}{2} - 2\right)\right]RT$$

$$\Delta H_L = a\Delta\, H_f^\theta\ (M^{b+})\ (g) + b\Delta H_f^\theta\ (X^{a-})\ (g) - \Delta H_f^\theta\ (M_aX_b)(c)$$

Where $n_{M^{b}+}$, $n_{X^{a}-}$ is equal to 3 for monatomic ions, 5 for linear polyatomic ions, and 6 for polyatomic nonlinear ions.

The data listed in Table 2 were employed in the calculation of the Born-Haber Cycle values in Table 1 and are not listed in Technical Notes 270 of the National Bureau of Standards.

$NH_4IO_2F_2$	678	Finch, Gates, Jenkinson (1972)	—	ThH_3	2711	Gibb (1962)	—
$AgIO_2F_2$	736	Finch, Gates, Jenkinson (1972)	— 685	PuH_3	2519	Gibb (1962)	—
				AmH_3	2544	Gibb (1962)	—

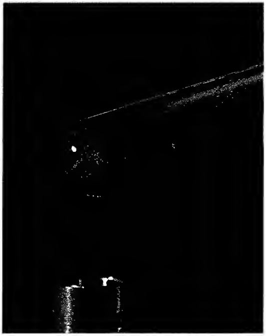
Table 1 (continued)
LATTICE ENERGIES

Salt	Calculated lattice energy (kJmol⁻¹)	Literature source	Thermochemical cycle lattice energy (kJmol⁻¹)
TiH_2	2866	Gibb (1962)	2845
ZrH_2	2711	Gibb (1962)	2999
CuH_2	2941	Karapet'yants (1954)	—
ZnH_2	2870	Karapet'yants (1954)	—
HgH_2	2707	Karapet'yants (1954)	—
AlH_3	5924	Gibb (1962)	—
FeH_3	5724	Gibb (1962)	—
ScH_3	5439	Gibb (1962)	—
YH_3	5063	Gibb (1962)	—
LaH_3	4895	Gibb (1962)	4493
FeH_3	5724	Gibb (1962)	—
GaH_3	5690	Gibb (1962)	—
InH_3	5092	Gibb (1962)	—
TlH_3	5092	Gibb (1962)	—
Hydroselenides			
NaHSe	703	Yatsimirskii (1956)	—
KHSe	644	Yatsimirskii (1956)	—
RbHSe	623	Yatsimirskii (1956)	—
CsHSe	598	Yatsimirskii (1956)	—
Hydrosulphides			
LiHS	759	Waddington (1959)	821
NaHS	704	Waddington (1959)	747
KHS	650	Waddington (1959)	659
RbHS	623	Waddington (1959)	637
CsHS	582	Waddington (1959)	595
NH_4HS	661	Yatsimirskii (1956)	666
$Ca(HS)_2$	2184	Yatsimirskii (1956)	(2171)
$Sr(HS)_2$	2063	Yatsimirskii (1956)	—
$Ba(HS)_2$	1979	Yatsimirskii (1956)	(1956)
Hydroxides			
LiOH	1021	Saloman (1970)	1039
NaOH	887	Saloman (1970)	900
KOH	789	Saloman (1970)	804
RbOH	766	Yatsimirskii (1956)	773
CsOH	721	Yatsimirskii (1956)	724
$Be(OH)_2$	3477	Finch, Gardner (1965)	3629
$Mg(OH)_2$	2870	Finch, Gardner (1965)	3006
$Ca(OH)_2$	2506	Finch, Gardner (1965)	2645
$Sr(OH)_2$	2330	Finch, Gardner (1965)	2483
$Ba(OH)_2$	2141	Finch, Gardner (1965)	2339
$Ti(OH)_2$	—	—	2962
$Mn(OH)_2$	2909	Wen, Sho (1975)	3008
$Fe(OH)_2$	2653	Karapet'yants (1954)	3055
$Co(OH)_2$	2786	Karapet'yants (1954)	3115
$Ni(OH)_2$	2832	Karapet'yants (1954)	3193
$Pd(OH)_2$	—	—	3175
$Cu(OH)_2$	2870	Karapet'yants (1954)	3237
CuOH	1006	Karapet'yants (1954)	—
AgOH	918	Karapet'yants (1954)	—
AuOH	1033	Karapet'yants (1954)	—
TlOH	705	Karapet'yants (1954)	—
$Zn(OH)_2$	2795	Yatsimirskii (1961)	3158
$Cd(OH)_2$	2607	Yatsimirskii (1961)	2918
$Hg(OH)_2$	2669	Karapet'yants (1954)	—
$Sn(OH)_2$	2489	Yatsimirskii (1961)	2729
$Pb(OH)_2$	2376	Yatsimirskii (1961)	2623
$Sc(OH)_3$	5063	Karapet'yants (1954)	—
$Y(OH)_3$	4707	Karapet'yants (1954)	—
$La(OH)_3$	4443	Karapet'yants (1954)	—
$Cr(OH)_3$	5556	Karapet'yants (1954)	—
$Mn(OH)_3$	6213	Wen, Sho (1975)	—
$Al(OH)_3$	5627	Karapet'yants (1954)	—
$Oa(OH)_3$	5732	Karapet'yants (1954)	—
$In(OH)_3$	5280	Karapet'yants (1954)	—
$Tl(OH)_3$	5314	Karapet'yants (1954)	—
$Ti(OH)_4$	9456	Karapet'yants (1954)	—
$Zr(OH)_4$	8619	Karapet'yants (1954)	—
$Mn(OH)_4$	10933	Brenet, Goelfier, Cabano (1963)	—
$Sn(OH)_4$	9188	Karapet'yants (1954)	—
Imides			
CaNH	3293	Altschuller (1955)	—
SrNH	3146	Altschuller (1955)	—
BaNH	2975	Altschuller (1955)	—
Metaniobates			
$NaNbO_3$	789	Lapitskii, Nebyhtsyn (1961)	—
$Ca(NbO_3)_2$	2315	Lapitskii, Nebyhtsyn (1961)	—
$Fe(NBO_3)_3$	2502	Lapitskii, Nebyhtsyn (1961)	—
Metatantalates			
$NaTaO_3$	789	Lapitskii, Nebyhtsyn (1961)	—
$Ca(TaO_3)_2$	2315	Lapitskii, Nebyhtsyn (1961)	—
$Fe(TaO_3)_3$	2502	Lapitskii, Nebyhtsyn (1961)	—
Metavanadates			
Li_3VO_4	3945	Golvkin, Fotiev (1970)	—
Na_3VO_4	3766	Golvkin, Fotiev (1970)	—
K_3VO_4	3376	Golvkin, Fotiev (1970)	—
Rb_3VO_4	3243	Golvkin, Fotiev (1970)	—
Cs_3VO_4	3137	Golvkin, Fotiev (1970)	—
Nitrates			
$LiNO_3$	848	Jenkins, Morris (1977)	848
$NaNO_3$	755	Jenkins, Morris (1977)	756
KNO_3	685	Jenkins, Morris (1977)	687
$RbNO_3$	662	Jenkins, Morris (1977)	658
$CsNO_3$	648	Jenkins, Morris (1977)	625
NH_4NO_3	661	Morris (1958)	676

Appendix B

Chemistry

JAMES P. BIRK ARIZONA STATE UNIVERSITY



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To the memory of my father, Albert Birk, who loved books and who would have enjoyed this one.

Warning: This book contains text descriptions of chemical reactions and photographs of experiments that are potentially dangerous and harmful if undertaken without proper supervision, equipment, and safety precautions. DO NOT attempt to perform these experiments relying solely on the information presented in this text.

Credits: A list of credits follows the index.

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Values for atomic weights listed in the periodic table on the inside front cover of this book are from the IUPAC report "Atomic Weights of the Elements 1989," *Pure and Applied Chemistry,* Vol. 63, No. 7 (1991), pp. 975–1002 (© 1991 IUPAC).

Printed in the U.S.A.

Library of Congress Catalog Card Number: 93-78645
Student text ISBN: 0-395-51535-1
Instructor's Annotated Edition ISBN: 0-395-69231-8

123456789-VH-96 95 94 93

Table 4.2 Some Solubility Rules for Inorganic Salts in Water

Na^+, K^+, NH_4^+	Most salts of sodium, potassium, and ammonium ions are soluble.
NO_3^-	All nitrates are soluble.
SO_4^{2-}	Most sulfates are soluble. Exceptions: $BaSO_4$, $SrSO_4$, $PbSO_4$, $CaSO_4$, Hg_2SO_4, and Ag_2SO_4
Cl^-, Br^-, I^-	Most chlorides, bromides, and iodides are soluble. Exceptions: AgX, Hg_2X_2, PbX_2, and HgI_2
Ag^+	Silver salts, except $AgNO_3$, are insoluble.
O^{2-}, OH^-	Oxides and hydroxides are insoluble. Exceptions: $NaOH$, KOH, NH_4OH, $Ba(OH)_2$, and $Ca(OH)_2$ (somewhat soluble)
S^{2-}	Sulfides are insoluble. Exceptions: salts of Na^+, K^+, NH_4^+ and the alkaline-earth metal ions
CrO_4^{2-}	Most chromates are insoluble. Exceptions: salts of K^+, Na^+, NH_4^+, Mg^{2+}, Ca^{2+}, Al^{3+}, and Ni^{2+}
CO_3^{2-}, PO_4^{3-}, SO_3^{2-}, SiO_3^{2-}	Most carbonates, phosphates, sulfites, and silicates are insoluble. Exceptions: salts of K^+, Na^+, and NH_4^+

gases, generally binary covalent compounds, are sufficiently insoluble to provide a driving force if they are formed as a reaction product. For example, many sulfide salts will react with acids to form gaseous hydrogen sulfide:

$$MnS(s) + 2HCl(aq) \longrightarrow MnCl_2(aq) + H_2S(g)$$

Insoluble gases are often formed by the breakdown of an unstable double-displacement reaction product. For example, carbonates react with acids to form carbonic acid, H_2CO_3, an unstable substance that readily decomposes into water

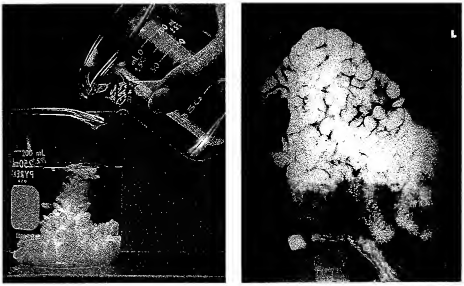

Figure 4.11 *Left:* Soluble barium chloride reacts with soluble sodium sulfate to form insoluble barium sulfate and soluble sodium chloride. *Right:* Barium compounds are extremely toxic, but barium sulfate is so insoluble that people preparing to have their digestive systems X-rayed swallow barium sulfate blended with water to make their digestive system visible to the X rays.

Appendix C

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ALIQUAT 175 – Item# 2717
Tributylmethylammonium chloride solution in water.

CETYLTRIMETHYLAMMONIUM BROMIDE, 98% – Item# 3557

TETRABUTYLAMMONIUM ACETATE 1 M, AQUEOUS – Item# 2515

TETRABUTYLAMMONIUM BOROHYDRIDE, 98% – Item# 2516

TETRABUTYLAMMONIUM BROMIDE REAGENT (ACS) – Item# 353
Polarographic Grade. A specially purified reagent suitable for supporting electrolyte in polarographic work.

TETRABUTYLAMMONIUM CHLORIDE, 1.0 M AQUEOUS – Item# 2432

TETRABUTYLAMMONIUM CHLORIDE, HYDRATE 98% – Item# 2462

TETRABUTYLAMMONIUM DIHYDROGEN PHOSPHATE – Item# 2433
99% Crystals

TETRABUTYLAMMONIUM HEXAFLUOROPHOSPHATE – Item# 2435

TETRABUTYLAMMONIUM HYDROGEN SULFATE – Item# 2517

TETRABUTYLAMMONIUM HYDROXIDE 0.4 M AQUEOUS, ELECTROMETRIC GRADE – Item# 2262
Contact GFS for lower purity grade

TETRABUTYLAMMONIUM HYDROXIDE 1.0 M IN METHYL ALCOHOL – Item# 2444
Methanol solution for HPLC

TETRABUTYLAMMONIUM HYDROXIDE 1.0 M, REAGENT (ACS), AQUEOUS – Item# 1202
Some solids may be present, which will redissolve upon heating to 40 C in a water bath.

TETRABUTYLAMMONIUM HYDROXIDE 40% AQUEOUS SOLUTION – Item# 2984
Some solids may be present, which will redissolve upon heating to 40 C in a water bath.

TETRABUTYLAMMONIUM HYDROXIDE 55% AQUEOUS – Item# 3575
Some solids may be present, which will redissolve upon heating to 40 C in a water bath.

TETRABUTYLAMMONIUM IODIDE REAGENT – Item# 225
Polarographic Grade. A specially purified reagent suitable for supporting electrolyte in polarographic work at very negative potentials.

TETRABUTYLAMMONIUM PERCHLORATE REAGENT – Item# 394
Tetra-n-butylammonium perchlorate. Suitable for use as polarographic supporting electrolyte.

TETRABUTYLAMMONIUM PHOSPHATE BUFFER, pH 7.5 – Item# 2436
Mixed phosphate buffer. Approximate tetrabutylammonium ion concentration 0.5 M.

TETRABUTYLAMMONIUM TETRAFLUOROBORATE – Item# 2434

TETRABUTYLAMMONIUM TRIFLUOROMETHANESULFONATE – Item# 2518

TETRAETHYLAMMONIUM ACETATE, 50% AQUEOUS SOLUTION – Item# 2519

TETRAETHYLAMMONIUM BROMIDE – Item# 1513
Suitable for use as polarographic electrolyte

TETRAETHYLAMMONIUM CHLORIDE MONOHYDRATE, 98% – Item# 1514

TETRAETHYLAMMONIUM HEXAFLUOROPHOSPHATE – Item# 2438
Not on the TSCA inventory.

TETRAETHYLAMMONIUM HYDROXIDE, 1.0 M AQUEOUS SOLUTION – Item# 2439

TETRAETHYLAMMONIUM HYDROXIDE, 20% AQUEOUS SOLUTION – Item# 2520

TETRAETHYLAMMONIUM IODIDE – Item# 2440

TETRAETHYLAMMONIUM NITRATE, 35% AQUEOUS – Item# 2522

TETRAETHYLAMMONIUM PERCHLORATE – Item# 511
Suitable for use as polarographic supporting electrolyte. Wet with 10% water.

TETRAETHYLAMMONIUM TETRAFLUOROBORATE – Item# 2437

TETRAHEXYLAMMONIUM IODIDE REAGENT – Item# 366
(Tetra-n-hexylammonium Iodide) Suitable as supporting electrolyte in polarography.

TETRAHEXYLAMMONIUM PERCHLORATE – Item# 512
(Tetra-n-hexylammonium Perchlorate) suitable for use as a polarographic

supporting electrolyte.

TETRAMETHYLAMMONIUM BROMIDE REAGENT (ACS) – Item# 1515

TETRAMETHYLAMMONIUM CHLORIDE – Item# 1516

TETRAMETHYLAMMONIUM FLUORIDE, TETRAHYDRATE 98% – Item# 2726

TETRAMETHYLAMMONIUM HEXAFLUOROPHOSPHATE – Item# 2442

TETRAMETHYLAMMONIUM HYDROGEN PHTHALATE, 99% – Item# 2524

TETRAMETHYLAMMONIUM HYDROXIDE PENTAHYDRATE – Item# 1680

TETRAMETHYLAMMONIUM HYDROXIDE, SOLUTION 1.0 Mol/L in WATER, REAGENT (ACS) – Item# 2275

TETRAMETHYLAMMONIUM HYDROXIDE, SOLUTION 25% in METHANOL – Item# 2523

TETRAMETHYLAMMONIUM HYDROXIDE, SOLUTION 25% in WATER – Item# 1204

TETRAMETHYLAMMONIUM IODIDE – Item# 2443

TETRAMETHYLAMMONIUM PERCHLORATE – Item# 510
Suitable for use as polargraphic supporting electrolyte.

TETRAMETHYLAMMONIUM SILICATE, 18% AQUEOUS SOLUTION – Item# 2525
Complex mixture of Tetramethylammonium hydroxide and silica in a 1:2 ratio

TETRAMETHYLAMMONIUM TETRAFLUOROBORATE – Item# 2441

TETRAPROPYLAMMONIUM BROMIDE, 98% – Item# 2526

TETRAPROPYLAMMONIUM CHLORIDE, 98% – Item# 2527

TETRAPROPYLAMMONIUM HEXAFLUOROPHOSPHATE – Item# 3500
Not on the TSCA Inventory

TETRAPROPYLAMMONIUM HYDROXIDE, 1 M AQUEOUS SOLUTION – Item# 2528
1 mol/L

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Tetramethylammonium hydroxide

From Wikipedia, the free encyclopedia

Tetramethylammonium hydroxide (TMAH) is a quaternary ammonium salt with the molecular formula $(CH_3)_4NOH$. It is used as an anisotropic etchant of silicon. It is also used as a basic solvent in the development of acidic photoresist in the photolithography process.

Toxicity

TMAH solution is a strong base. Its Tetramethylammonium ion can damage nerves and muscles, causing difficulties in breathing and possibly death in a short period of time after exposure by contact even with a small amount.

External links

Retrieved from "http://en.wikipedia.org/wiki/Tetramethylammonium_hydroxide"

Categories: Quaternary ammonium compounds | Organic compound stubs

Appendix D

A Guide to Solvents and Reagents in Introductory Organic Chemistry for students in 2.222

Dr. P.G. Hultin, February 2002

1.6. Hydrocarbon Solvents

Hydrocarbon solvents are generally inert to reagents of all kinds. They are neither acidic nor basic, in either the Lewis or Bronsted senses. They will only dissolve low polarity organics, although the *aromatic solvents* are a bit more tolerant in this regard. Hydrocarbon solvents provide a reaction environment that is as close to the gas phase as a solution can get.

The main factor dictating the choice of one hydrocarbon over another is *boiling point*, if the reaction involves heating, or *melting point*, if the reaction is to be done at low temperature.

Common Aliphatic Solvents: Pentane (mostly isomers of C_5H_{12}, bp 35-36 °C), Hexanes (mostly isomers of C_6H_{14}, bp 69 °C), iso-Octane (2,2,4-trimethylpentane, C_8H_{18}, bp 98-99 °C), and decalin (perhydronaphthalene, $C_{10}H_{18}$, bp 189-191 °C).

Common Aromatic Solvents: Benzene (C_6H_6) bp 80 °C, Toluene ($C_6H_5CH_3$) bp 111 °C, and Xylenes (*o,m,p* isomers of $C_6H_4(CH_3)_2$) bp 140 °C.

Benzene is no longer used as a reaction solvent because of its carcinogenicity. Toluene and Xylenes are much safer and are usually equivalent substitutes.

One of the main uses of aromatic solvents is their ability to remove water by *azeotropic distillation*. For example, the toluene/water azeotrope, boiling at 84 °C, contains 14% water. Reactions that generate water, such as elimination of OH groups or ester formation, can be done in boiling toluene. When the vapour is condensed, the water is not miscible with the toluene and can be removed while the toluene is returned to the reaction vessel.

1.7. Amine Solvents

Several "special purpose" organic solvents are encountered from time to time. The most common of these are the *amines*, which are Bronsted and Lewis bases. Reactions that generate protons are frequently performed in the presence of amine bases, and occasionally the amine is the solvent for the process. The properties of common amines are also discussed under the "Reagents" heading.

Triethylamine (Et_3N, $(CH_3CH_2)_3N$): MW 101.19, density 0.726 g/mL, mp –115 °C, bp 90 °C.

Triethylamine is miscible with water and with most organics. Thus it has become one of the most common organic bases. It is often used as a reagent or a co-solvent, but it can be used as the solvent for several types of reactions as well. It is unfortunately rather smelly, as are most amines.

Pyridine (Pyr, Error! Objects cannot be created from editing field codes., C_5H_5N): MW 79.102, density 0.983 g/mL, mp –42 °C, bp 115 °C.

Pyridine is an aromatic amine. It is less basic than is triethylamine, but it is quite nucleophilic because the nitrogen lone pair is very exposed. It is used as a solvent for many of the same reactions that triethylamine might be used for. Pyridine is also very soluble in water.